Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 73 of the Commission's Rules to Clarify the Definition and Measurement of Aural Modulation Limits in the Broadcast Services	)	MM Docket No. 93-225

To: The Commission

REPLY COMMENTS OF BELAR ELECTRONICS LABORATORY, INC.

The Commission outlined two basic issues in this inquiry:

(1) What should be the definition of overmodulation? Should Rule 73.1570 be kept (with clarifications) or should new emission limitations be adopted in lieu of an overmodulation standard?

(2) What methods or procedures are required to implement any proposed limits on modulation levels?

The Commissions itself considers limits on station aural modulation to be among the most important of the Commission's technical standards due to their direct effect on the quality of

radio service. Other fundamentally important operational standards include regulating out-of-band and spurious emissions. While these issues are present in the AM, FM and TV services, Belar directs most of its attention to the issue of modulation in the FM service.

PRESENT MODULATION STANDARD HAS BOTH TECHNICAL AND EMPIRICAL VALIDITY

Belar's original Comment and the statements of fact and experience contained in comments of several of the other parties to this proceeding present compelling arguments to maintain peak frequency deviation as the regulatory modulation standard for FM.

As indicated in Belar's Comment, while the relation between a station's peak modulation level and its occupied bandwidth is complex, the relation is direct. Unfortunately, short of specifically defining the modulating signal, the relation between modulation peaks and spectrum must necessarily remain statistical. As Belar stated in its Comment, with the assumption of a simplistic Gaussian noise model for program material, one is led to conclude that for monaural programming the RMS bandwidth is proportional to the RMS frequency deviation, i.e. the RMS level of the modulation signal.[1] The empirical evidence backing this statement is the years of experience correlating the peak

[1] The relationship between RMS modulation and peak modulation is only a rough proportionality, with the exact relationship determined by the signal and the nature and amount of processing applied to the signal.

modulation levels of FM stations to their occupied bandwidths. For this most obvious reason, it is expected, and confirmed by RF spectrum photographs submitted in Belar's Comment, that any measure taken to allow modulation peaks to exceed 75 kilohertz (kHz)[2] peak deviation will increase the level of interference and the distortion experienced by stations and listeners.

It has been suggested that regulating RMS deviations directly might discourage the over-use of audio compression equipment and result in an increase in the dynamic range available to the listening public. While it is technically feasible to measure time-averaged RMS signal levels, placing requirements directly on RMS deviations would not eliminate the need for supplementary peak deviation limitations. The unfortunate effect of the combination of both types of limits would be that the Commission would then be involved in setting policies on how stations processed their program material. Also, rules affecting both RMS and peak deviations are complicated by the variety of subsidiary services offered by FM stations.[3]

One area of agreement among several parties filing Comments to this Notice of Inquiry is the dependence of receiver performance on the past modulation practices of FM broadcast stations. The performance of receivers to currently prescribed

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[2] It is understood this limit may be extended to 82.5 kHz for stations with more than one subcarrier.

[3]The steady-state components of the pilot and SCA signals introduce a DC component to modulation indications which change the peak-to-RMS ratios, invalidating them for use as a modulation standard.

modulation levels is quite predictable. The presence of modulation peaks regularly exceeding 75 (82.5) kHz deviation will necessarily degrade the aggregate performance of consumer receivers.[4] Any change from current modulation practice threatens the interoperability and performance of literally hundreds of millions of receivers designed on the basis of the present modulation standards and already in the hands of consumers.

FM EMISSION LIMITATION INCONVENIENT AND EXPENSIVE

Several of the filings in reference the Notice of Inquiry have correctly noted the difficulty not only in specifying the appropriate parameters of occupied bandwidth to maintain present levels of interference, but in measuring the parameters as well. As pointed out by other filings in this matter, and previously in this filing, an analysis of the precise impact of program modulation on the RF spectrum and the quantification of the resulting interference levels at receivers, if done properly, would require a major engineering study.

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[4] It is interesting to note the absence of Comments from receiver manufacturers in this proceeding. In an informal conversation with a representative of the electronics arm of one of the "Big Three" automakers, Belar was told that the industry doesn't believe the Commission attaches much significance to input from receiver manufacturers. It is also disappointing to learn that, because of the lack of dynamic range and financial considerations that have degraded the main audio program (e.g. high-speed data SCA's), this representative personally no longer considered FM a high-quality delivery source.

If an occupied bandwidth measure were adopted, we would be substituting an imprecise measure for setting modulation for one that is well-defined and known to be highly accurate. The nature of conventional spectral measurement of emissions requires the accumulation over a long time period of time of the maximum detected levels falling in the passband of what is essentially a scanning bandpass filter. Unfortunately, the width of the passband of the filter combines with its scanning rate to limit the accuracy of the spectrum displayed. In modern FFT analyzers, a long accumulation period is still required so that the signal maxima collected in each band are reliable.

It has been noted that compliance with modulation rules requires continuous monitoring. If an occupied bandwidth measure were instituted, without new designs for simplified spectrum measuring devices, stations would be required to invest in expensive spectrum analyzers. In addition to requiring long intervals for evaluation of signals, they would require operation by highly trained engineering personnel. Requiring an expensive piece of equipment operated by an expensive engineer to obtain a coarse measurement is ludicrous.

Paragraph 11 of the Commission's Notice of Inquiry correctly states that the permissible occupied bandwidth for FM stations specified in Section 73.317 of the Rules and Regulations was based on a standard set many years ago. The original intent was only indirectly aimed at limiting interference generated by program material. The rule was primarily intended to guarantee a

minimum performance level of a specific type of exciter (phase-modulated) known to generate excessive spurious RF output. This mask was designed to solve a problem that no longer exists. To begin engineering studies of appropriate occupied bandwidths, as several comments suggest, would require discarding this mask and beginning again.

RESPONDENTS OVERWHELMINGLY DESIRE A CLEAR AND SIMPLE STANDARD — "HOW MUCH AND HOW LONG CAN I OVERMODULATE?" OR "WHAT ARE PEAKS OF FREQUENT RECURRENCE?"

There seems to be a general consensus among the technical practitioners filing in this Inquiry that to attempt to institute an emissions limitation for the FM service would complicate station operations with small potential for gain — but at a large risk. Years of hands-on technical experience are saying, "Keep it simple."

Consideration of two simultaneous standards — conventional peak modulation **and** emissions limitations — is even more ludicrous.

Respondents noted that with the sophisticated processing hardware in common use, stations are able to maintain a given instantaneous peak modulation within about two percent, even while maintaining spectrally clean composite signals — and without composite clipping.

Given the capability of modern processors to maintain such tightly controlled peak levels, an absolute modulation limit of

75 (82.5) kHz peak deviation, similar to the absolute 125% limit for positive peaks in the AM service, is reasonable.

An absolute instantaneous peak deviation limit has the great advantage of being simple and easily verifiable using conventional modulation monitors. Eliminating the troublesome phrase "peaks of frequent recurrence" would go a long way to halt the runaway situation in which stations now find themselves. The loss in modulation level to stations with state-of-the-art processing who monitor instantaneous peaks would be almost inconsequential.

If the Commission feels it appropriate to maintain the "peaks of frequent recurrence" rule, there is overwhelming support to define this phrase exactly. "How much and for how long can I overmodulate?"

This rule was instituted at a time when processing, transmitting, and monitoring equipment was not nearly so stable and well-designed. Maintaining the rule under current circumstances would allow stations "room for error" in that complex signal waveforms that only occasionally exceed specified limits would not be the culprit in forcing a station to greatly reduce overall modulation in an effort to avoid ever exceeding the 75 (82.5) kHz limit.

Maintaining Rule 73.1570, with an absolute limit or with a defined peaks of frequent recurrence count limit, would allow most stations to keep their present monitoring equipment. If a small number of peaks were specifically allowed to exceed 75

(82.5) kHz deviation, with no peak weighting permitted, operators would be able verify compliance with a modulation monitor that meets pre-1983 Type Approval rules and a wristwatch. This answers the question, "How much and how long can I overmodulate?"

IMPORTANT TO HAVE SIMPLE AND VALID MEASURE

Several filings from station technical personnel and independent technical consultants expressed the desirability to have a simple and economical measure for modulation and overmodulation. Belar's position is that instantaneous peak frequency deviation is such a measure. As outlined earlier, and as shown in RF spectrum photographs in our Comment filing, peak deviation is known to correlate quite well with occupied bandwidth, a measure that one would expect to relate directly to the potential for interference.

To illustrate the inconsistencies between peak-weighted modulation and instantaneous peak deviation, Belar and others submitted performance reports for peak-weighted modulation instruments. Peak weighting circuits similar to those in commercially produced instruments, in our experience, can give significantly lower peak indications for stereophonic FM composite signals than circuits without peak weighting, as the peak weighting algorithms ignores part of the L-R.[5] The

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[5]Indeed, this is the very claim that one manufacturer of a measuring device used to promote his product, promising several dB of increased modulation solely by employing his product to make the measurement.

reduction is even more pronounced for those composite signals carrying SCA signals. Clearly it does not make sense to discount the effects of SCA modulation of the FM carrier, especially in light of the fact that the Commission already allows a higher modulation for stations with SCAs. Peak weighting is inappropriate for measuring deviation for stations providing a mix of standard and SCA services, unless Section (b)(2) of Rule 73.1570 is deleted.[6]

COMMON MEASUREMENT METHOD DESIRABLE

Interest was expressed in filed comments for a modulation standard that would allow broadcasters to obtain the same results as the Commission obtains when verifying compliance. Clearly, unless similar methods are employed by the broadcasters and the FCC Field Offices to measure modulation, situations are likely to arise where discrepancies between the readings exist — to no positive end.

Belar believes that conventional electronic approaches provide significantly more accuracy than may be obtained by relying on visual interpretation of an oscilloscope display.

There was interest expressed in re-instituting Type Approval procedures for modulation monitors by several respondents to the Notice. Belar concurs with the Commission that there is

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[6] This section allows up to 10% additional modulation for stations with subcarriers.

insufficient evidence at this time to justify a return to Type Approval, particularly if the Commission clarifies Rule 73.1570.

It is noted that this proceeding was in part motivated by the variation in modulation indicated by monitors currently marketed to the broadcast industry.[7] In response to one filing in regard to this matter, Belar would like to suggest that accuracy per se is not the primary difficulty, but rather differing methods of modulation measurement combined with the variation in interpretation of the word "overmodulation".

The competitive marketplace for monitoring hardware, combined with an absence of a precise definition of over-modulation, has led to a "loose" interpretation of the Rules by some manufacturers. The answer to the broadcaster's question of "How much and for how long?" should not depend on which monitor manufacturer he asks. High standards of accuracy are no longer limited by technology.

As discussed above, Belar concurs with the Commission that a return to Type Approval of modulation monitors is not required at this time. It is suggested, that if the Commission is concerned about compliance with a more tightly defined Rule 73.1570, that compliance be monitored for some time after any Rulemaking. If it becomes clear during that period that monitor performance is a significant factor in non-compliance, then reconsideration of Type Approval might be warranted.

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[7] Belar contends that the monitors in question are exclusively those designed and manufactured after the Commission ceased regulating modulation monitors.

WHAT ARE THE INTERESTS OF THE SILENT PARTY IN THIS MATTER -- THE PUBLIC?

Unfortunately in this proceeding, two major groups are not directly represented: the receiver manufacturers and the listening public.

While many comments have been made concerning the desirability of maintaining a peak modulation standard to guarantee the interoperability and maximum performance of commercially available receivers, no receiver manufacturer filed a Comment in this proceeding. A few parties filing believe they understand receiver manufacturers' interests in this matter, but without formal statements from the receiver manufacturers, this is speculation. It is possible that some manufacturers are unaware of this proceeding and its potential effects on their products. It would be appropriate for the Commission to invite comments specifically from receiver manufacturers.

To our knowledge no comments were solicited or received from citizens or public interest organizations. All the Comments noted so far have come from "lobbyists": broadcasters and their professional advocacy organizations and broadcast equipment manufacturers. No word has come from any of the tens of millions of people for which these proceedings will make some difference.

It is believed that regulators often pay undue attention to those interests that are most well represented. It is Belar's hope that the Commission considers most seriously those interests

of the citizens for which it has been charged to guarantee quality radio service.

SUMMARY

The Commission outlined two basic issues in this inquiry. First, how should overmodulation be defined if not redefined by an emission standard. Second, what methods or procedures are required to implement the modulation standard.

The Comments filed in response to this inquiry have shown broad interest in a clear, precise restatement of the current rules. Support for this position is justified in that it assures the integrity of the spectrum and guarantees a quality broadcast service in the public interest. There is little interest in occupied bandwidth measurements.

The only reasonable position that will end this controversy, short of an inappropriate and undesirable return to Type Approval for modulation monitors, is for the Commission to eliminate the ambiguity in the definition of peak modulation by removing the phrase "on peaks of frequent recurrence" from Rule 73.1570. This would eliminate the question **"How much can we overmodulate, and for how long?"**

Respectfully submitted,

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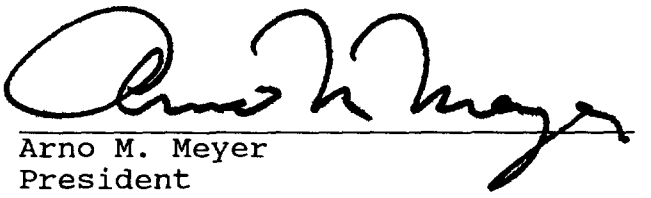

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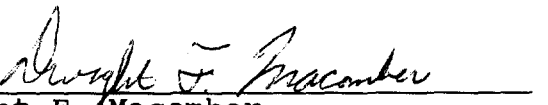

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